LEB-0025 Gate Driver Evaluation Mainboard for TO-247-3L Packages

Introduction

Littelfuse offers a broad range of power semiconductor gate drivers with various features. These include both isolated and non-isolated drivers of different current classes, as well as drivers that incorporate safety features like desaturation detection, soft turn-off, and fault state feedback. A gate driver evaluation platform has been introduced to enable customers to evaluate the gate driver portfolio under comparable conditions. This platform includes multiple gate driver boards that are compatible with mainboards designed for different power semiconductor packages. This manual describes the platform's mainboard for TO-247-3L packages. It enables testing of various combinations of gate drivers and power transistors within the same setup. The mainboard can be equipped with different gate driver evaluation boards and various power transistors in TO-247-3L packages.

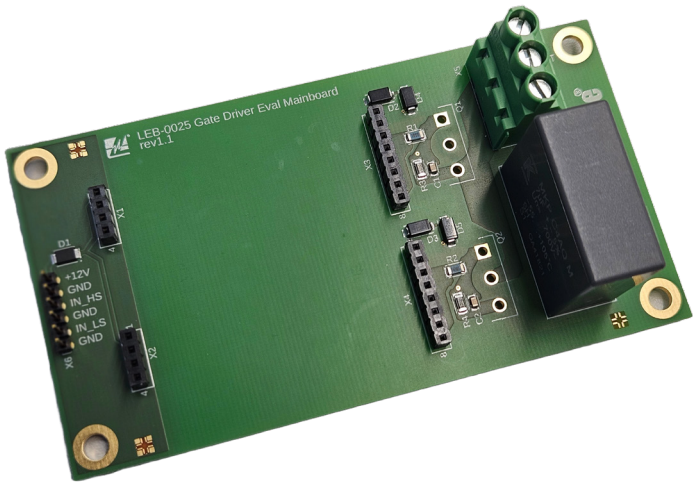

Figure 1. Littelfuse gate driver evaluation platform mainboard for TO-247-3L

Features

- Ability to test and compare different Littelfuse gate driver solutions with power semiconductors in TO-247-3L packages
- Maximum operating voltage: 500 V
- Suitable for double pulse and application related testing

Target Audience

This manual is intended for engineers working on power electronics hardware design and investigating optimal gate driver and power semiconductor solutions for their applications.

Contact Information

For more information on the evaluation board and application support, contact the Littelfuse Power Semiconductor team of product and applications experts: PowerSemiSupport@Littelfuse.com

Important Notes

Disclaimer Notice: The Customer (individually or, if you are acting on behalf of a company, the company) agrees to use the Evaluation Board solely for this purpose and subject to the terms of this Notice.

The design of the Evaluation Board has been tested by Littelfuse only as described in this document. The design is not qualified in terms of safety requirements, manufacturing, and operation over the entire operating temperature range or lifetime.

The Evaluation Board is an engineering tool intended solely for laboratory use by qualified and experienced electrical engineers to evaluate the performance of Littelfuse power semiconductors and integrated circuit products according to the terms and conditions set forth in this document or other related documents supplied with the respective Evaluation Board. The Evaluation Board should not be used at all or as part of a finished product.

The Evaluation Board provided by Littelfuse is subject to functional testing only under typical load conditions. The Evaluation Board is not subject to the same procedures as regular products regarding returned material analysis (RMA), process change notification (PCN), and product discontinuation (PD). Applications described are for illustrative purposes only and Littelfuse makes no representation that such applications will be suitable for the customer's specific use without further testing or modification.

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It is the responsibility of the Customer's technical departments to evaluate the suitability of the Evaluation Board for the intended application, based on their own performance criteria, conditions, specific application, compatibility with other components, and environmental conditions further to evaluate the completeness and correctness of the information provided in this document with respect to such application. The Customer is obliged to ensure that the use of the Evaluation Board does not cause any harm to persons or third-party property. The Evaluation Board and any information in this document is provided "as is" and Littelfuse disclaims any warranties, express or implied, including but not limited to warranties of non-infringement of third-party rights and implied warranties of fitness for any purpose, or for merchantability. There is no representation that operation of the Evaluation Board will be uninterrupted or error free.

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The Evaluation Board is not a standard consumer or commercial product. As a result, any indemnification obligations imposed upon Littelfuse by contract with respect to product safety, product liability, or intellectual property infringement do not apply to the Evaluation Board.

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1. Overview

Figure 2 displays the block diagram of the gate driver evaluation mainboard for TO-247-3L packages. This board comes without pre-mounted power semiconductors, allowing customers to test power semiconductors according to their preferences. Standard double pulse tests or other non-continuous tests can be conducted when the power semiconductors are mounted on the top side of the board. For continuous operation, the power semiconductors should be mounted on the bottom side to enable attachment to a heatsink. The desired driver evaluation boards are plugged onto the connectors X1 and X3 for high side connection, and X2 and X4 for low side connection, respectively, for testing purposes. The supply voltage and the control signals are provided through connector X6. Terminal block X5 is used for connecting the DC-Link-voltage and auxiliary components, such as a choke or a resistor for double-pulse tests.

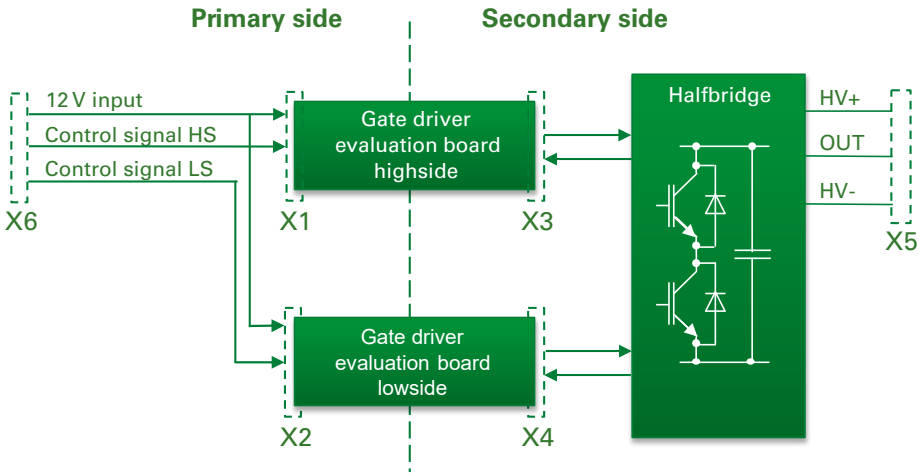

Figure 2. Gate driver evaluation mainboard block diagram

Table 1 contains the operating conditions of the driver evaluation mainboard.

Table 1. Operating conditions of the gate driver evaluation mainboard

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
V_{CC}	Board primary side supply voltage	11	12	13	V
$U_{control}$	Primary side control signal input voltage	–	5	5.5	V
U_{HV}	Secondary side operating voltage(1)	–	–	500	V
I_{HV}	Secondary side load current(2)	–	–	50	A
T_{amb}	Operating ambient temperature	0	25	50	°C

Notes:
(1) See Section 5 for further details on isolation ratings.
(2) Operation in double pulse test. Not for continuous operation.

Please be aware that depending on the power semiconductor in use, the gate driver voltages on the driver evaluation boards must be adjusted accordingly. In standard configuration, the driver evaluation boards are equipped with power supply of +15/-9 V.

2. Pin Assignments

Table 2 describes the electrical connections of the mainboard. A 4-terminal socket strip is used to connect the gate driver evaluation boards on the primary side. On the secondary side, the evaluation boards are connected via an 8-terminal socket strip. The power circuit is connected via a 3-pole terminal block.

Table 2. LEB-0025 pin assignments

Connector Name	Pin Number	Pin Name	Description
X1	1	12 V	+12 V supply high-side gate driver
X1	2	GND	Primary-side GND
X1	3	IN+	PWM input high-side gate driver
X1	4	GND	Primary-side GND
X2	1	12 V	+12 V supply high-side gate driver
X2	2	GND	Primary-side GND
X2	3	IN+	PWM input high-side gate driver
X2	4	GND	Primary-side GND
X3	1	DESAT_FB	High-side desaturation detection feedback pin (reserved for IX4352NE)
X3	2	SOURCE_EMITTER	High-side power transistor source/emitter connection
X3	3	DRIV_OUT	High-side gate driver evaluation board gate output
X3	4	SOURCE_EMITTER	High-side power transistor source/emitter connection
X3	5	DRIV_OUT	High-side gate driver evaluation board gate output
X3	6	SOURCE_EMITTER	High-side power transistor source/emitter connection
X3	7	DRIV_OUT	High-side gate driver evaluation board gate output
X3	8	GATE_FB	High-side gate feedback pin (reserved for IX4352NE)
X4	1	DESAT_FB	Low-side desaturation detection feedback pin (reserved for IX4352NE)
X4	2	SOURCE_EMITTER	Low-side power transistor source/emitter connection
X4	3	DRIV_OUT	Low-side gate driver evaluation board gate output
X4	4	SOURCE_EMITTER	Low-side power transistor source/emitter connection
X4	5	DRIV_OUT	Low-side gate driver evaluation board gate output
X4	6	SOURCE_EMITTER	Low-side power transistor source/emitter connection
X4	7	DRIV_OUT	Low-side gate driver evaluation board gate output
X4	8	GATE_FB	Low-side gate feedback pin (reserved for IX4352NE)
X5	1	HV+	Load circuit positive terminal
X5	2	HV-	Load circuit negative terminal
X5	3	OUT	Half-bridge output terminal
X6	1	+12V_LV	+12V board supply
X6	2	GND_LV	Primary-side GND
X6	3	IN+_HS	High-side driver PWM input
X6	4	GND_LV	Primary-side GND
X6	5	IN+_LS	Low-side driver PWM input
X6	6	GND_LV	Primary-side GND

3. Schematics

The mainboard's schematic is depicted in Figure 3. On the left side, the driver control signals and the 12 V power supply are routed directly from connector X6 to the connectors X1 and X2 of the evaluation boards. The 12 V power supply line is equipped with reverse polarity protection. The right side of the schematic shows the power semiconductor circuitry on the mainboard. The power semiconductors in the TO-247-3L package are connected in a half-bridge configuration, connected to a DC-Link with passive discharge resistors. For using the LEB-0023 IX4352NE driver evaluation board, the mainboard is equipped with diodes necessary for desaturation detection function. When using other evaluation boards, the DESAT diodes are not required and the corresponding pin on the evaluation is not assigned.

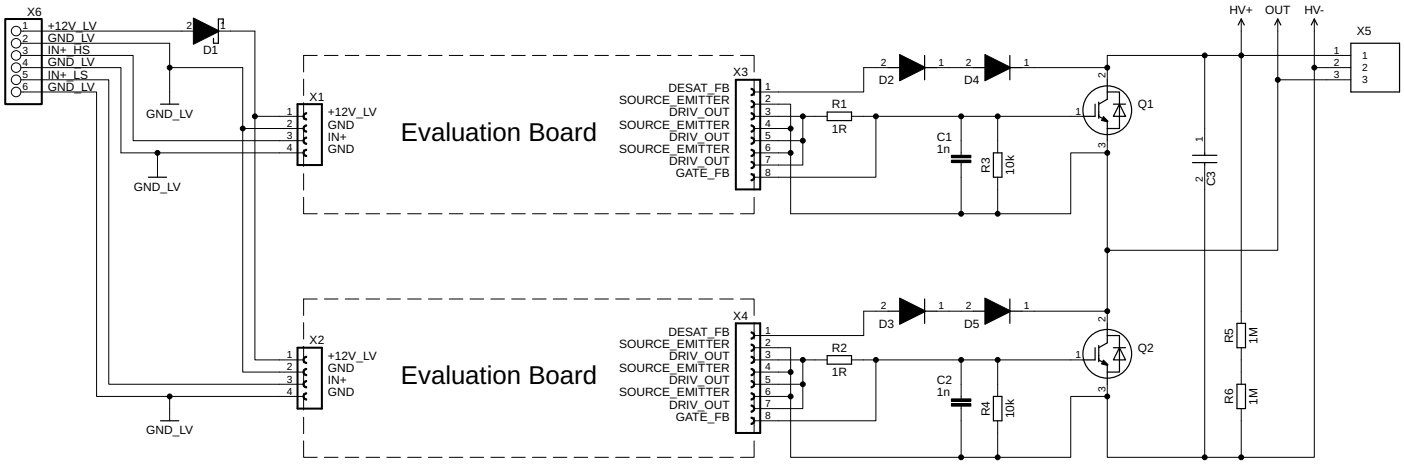

Figure 3. TO-247-3L mainboard schematics

4. Bill of Materials

Table 3 contains the evaluation board's bill of materials.

Table 3. Bill of materials for the gate driver evaluation mainboard

Item	Quantity	Reference	Value	Description	Manufacturer	MPN
1	2	C1, C2	1 nF	Cap 1 nF 10 % X7R 0805	- generic -	–
2	1	C3	7 µF	Film Cap 700 V 7 µF 5 %	Kemet	C4AQJBU4700M1YJ
3	2	R1, R2	1 Ω	Res 1 Ω 1 % 1206	- generic -	–
4	2	R3, R4	10 kΩ	Res 10 kΩ 10 % 1206	- generic -	–
5	2	R5, R6	1 MΩ	Res 1 MΩ 3 kV 5 % 2512	- generic -	–
6	1	D1	–	1 A low V_F Schottky barrier rectifier	Nexperia	PMEG6010EP,115
7	4	D2, D3, D4, D5	–	Hyperfast Rectifier 1200 V/1 A	Vishay Semiconductors	VS-E7MH0112-M3/I
8	2	Q1, Q2	–	Power semiconductor 650 V TO-247-3L	Littelfuse	–
9	2	X1, X2	–	.100" Closed Entry Low Profile Socket Strip	SAMTEC	CES-104-01-T-S
10	2	X3, X4	–	.100" Closed Entry Low Profile Socket Strip	SAMTEC	CES-108-01-T-S
11	1	X5	–	Fixed Terminal Block 3P 6.35 mm 90°	Phoenix Contact	1714968
12	1	X6	–	Pin header 0,1" pitch 6-pin	SAMTEC	TSW-106-23-H-S

5. Isolation Ratings

The creepage distances between primary- and secondary-side on the mainboard are 51.75 mm. The isolation capability between primary- and secondary-side of the overall setup is therefore given by the isolation capability of the gate driver evaluation board, which is mounted on the mainboard. Please pay attention to the user manual of the respective driver evaluation board.

The board is specified for a maximum operating voltage of 500 V. In accordance with the IEC 60664-1 standard, the assumption of pollution degree 2 and material group 1 of the PCB-material, the required creepage distances for 500 V operating voltage are 2.5 mm.

6. PCB Layout

Figures 4 to 7 display the four copper layers of the PCB.

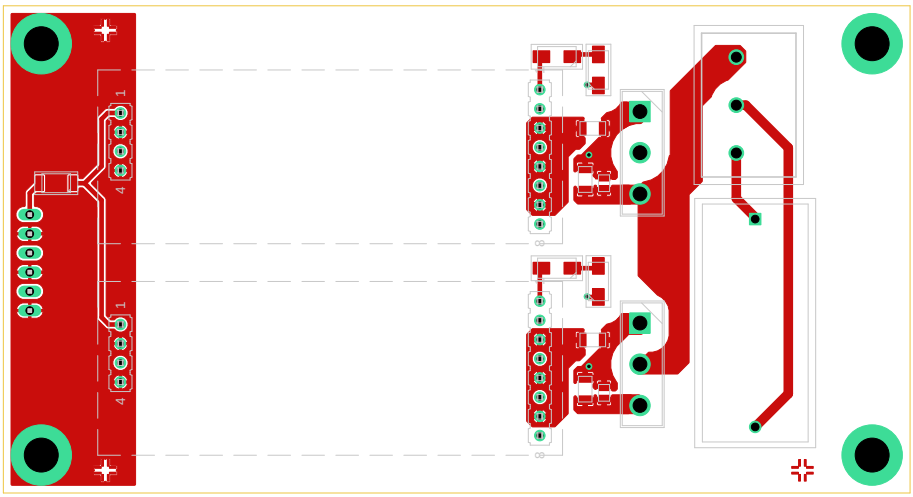

Figure 4. PCB top layer

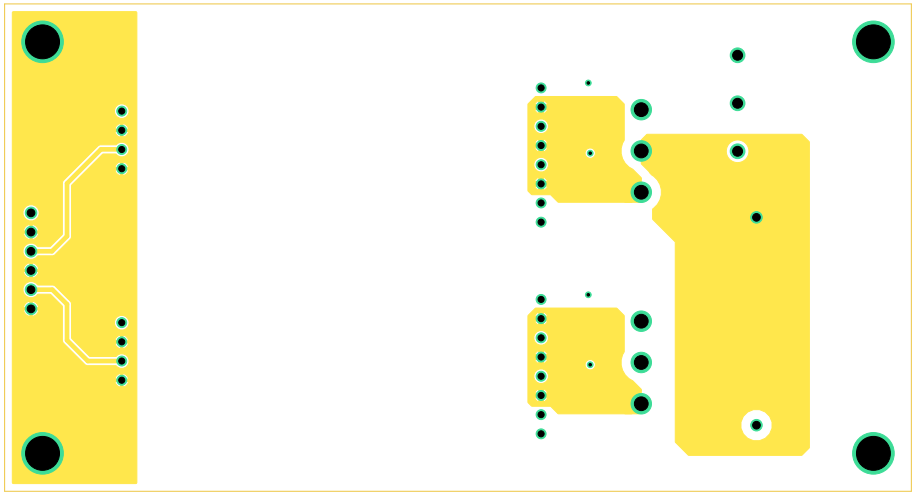

Figure 5. PCB layer 2

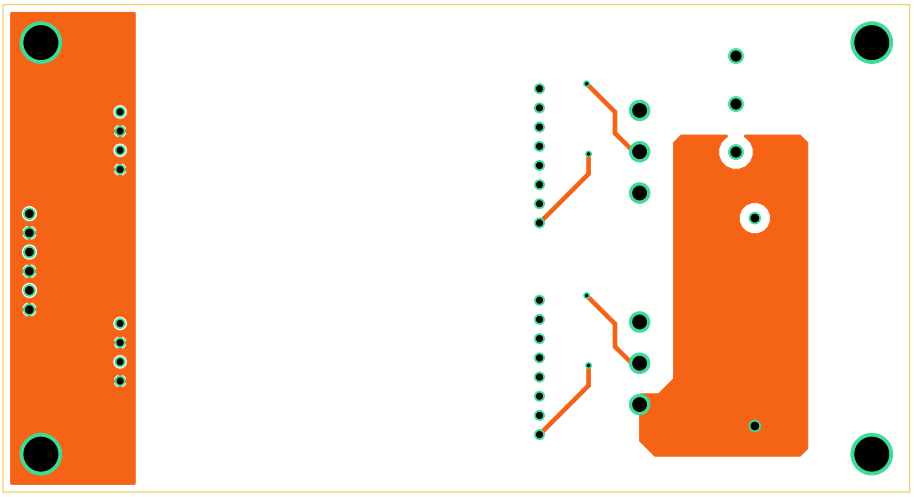

Figure 6. PCB layer 3

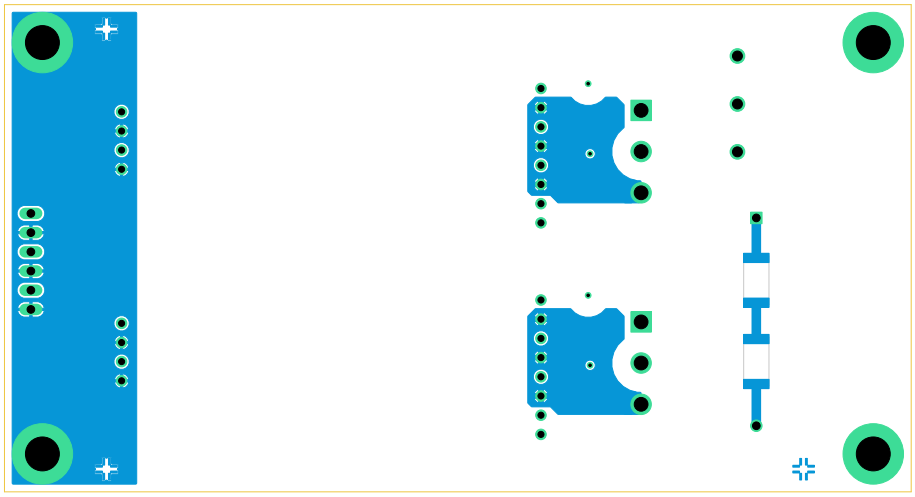

Figure 7. PCB bottom layer

7. PCB Assembly Data

Figures 8 and 9 depict the PCB assembly, including the mechanical dimensions of the mainboard.

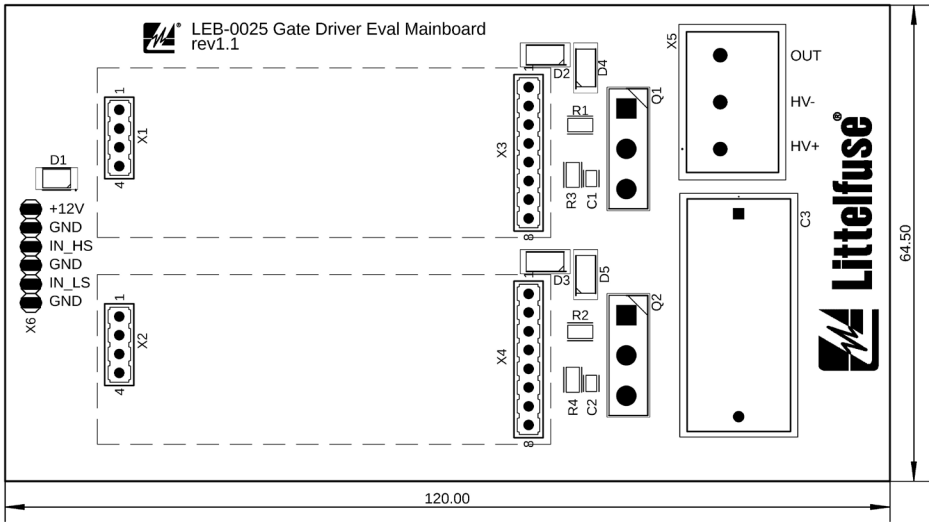

Figure 8. PCB top assembly and dimensions

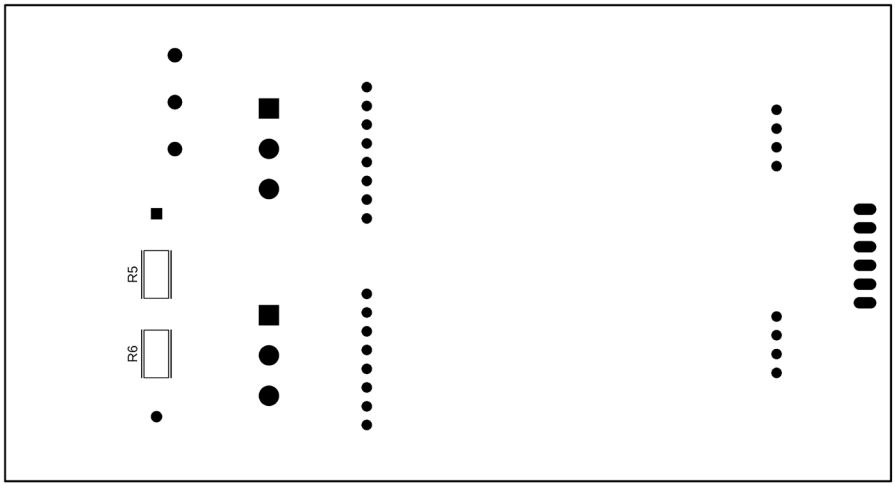

Figure 9. PCB bottom assembly

Revision History

Date	Revision	Changes
April 2025	1.0	Initial Release